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Adherence of adult cystic fibrosis patients with airway clearance and exercise regimens

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Abstract

Background: Regular airway clearance and exercise form an important part of the physiotherapy management of patients with cystic fibrosis (CF). Previous research has found that adherence of these patients with physiotherapy regimens is variable and influenced by factors such as sex and disease severity. To date, the adherence of Australian patients with CF has not been investigated. The aim of this study was to measure the adherence of a sample of Australian adult patients with CF and to ascertain factors that improved or decreased their adherence with physiotherapy.
Methods: Patients attending an Australian CF Unit were surveyed by an independent physiotherapist using a questionnaire based on the Manchester Cystic Fibrosis Compliance Questionnaire.
Results: Fifty seven of the 84 patients registered with the Unit (67.9% response rate) completed the survey. Over the previous six months, 96.5% of patients reported doing some form of airway clearance, with 70.2% doing this daily or only occasionally missing one or two days. Regular exercise was performed by 91.2% of patients when well, with 77.8% also exercising regularly when unwell. The most common reasons for non-adherence with airway clearance regimens were being too busy and not being bothered. Being too busy and too tired were the most frequent reasons for decreased adherence with exercise. Frequency of performing airway clearance regimens significantly improved when patients felt unwell. Adherence with exercise regimens was significantly higher in those who worked or studied full time.
Conclusion: Overall, the levels of adherence with physiotherapy regimens found in this study were considered to be satisfactory and higher than those previously reported in the literature, with time related factors being the most commonly reported reasons for decreasing adherence.

1. Introduction

An increased number of patients with cystic fibrosis (CF) are now surviving into adulthood, with the median age of survival being 29 years [1], and for those born in the 1990s the median age of survival is predicted to be more than 40 years [2]. This increased life expectancy is due to advances in the treatment of the disease and improved quality of care by multidisciplinary CF Units [3]. Pulmonary disease remains the most common cause of morbidity and mortality, with patients suffering recurrent exacerbations and progressive deterioration of their pulmonary function [4]. The performance of regular airway clearance techniques and exercise form an important part of the management of the pulmonary disease for patients with CF, both in terms of maintaining health, preventing deterioration and treating pulmonary exacerbations as they occur.

Adults with CF try to lead normal, independent lives that include work, study, an active social life and development of family and other relationships. In addition, they need to carry out their own time consuming, daily treatment regimen that includes nutritional supplementation, medication, airway clearance techniques and exercise to maintain their health and slow the progression of their disease. Adhering to this regimen can be very difficult, as daily treatment time may amount to several hours. The level of adherence to treatment regimens by patients with CF is variable [5–9]. In a study by Shepherd et al. [5] investigating compliance amongst 37 adults, 76% were considered compliant with medication regimens, whereas only 54 and 57% were considered compliant with their airway clearance and exercise regimens respectively. Abbott et al. [6],

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Conway et al. [7] and Walters and Warren [8] reported similar results. In contrast Konstan et al. [9] reported that 88% of 3675 patients aged 18 years and older, performed 'airway clearance therapy'. However, these authors did not report on the frequency or duration of treatment which may explain this disparity in apparent adherence. To date no study has specifically investigated the level of adherence to airway clearance and exercise regimens in an Australian sample of patients with CF.

Several authors have suggested factors that may influence the adherence of patients with CF to their treatment regimens [6,9–15]. These included disease severity, with improved adherence associated with more severe disease [9,12], and sex, with males demonstrating better adherence [10]. Improved adherence was also reported for patients who performed treatment independently [9] whereas Abbott et al. [6] reported improved compliance if patients received help with treatment. Other factors such as feeling immediate improvement in symptoms post-treatment, regular contact with their physiotherapist, encouragement and support from carers, and a better understanding of the rationale for treatment were also found to improve adherence [6,9,11,13].

The aim of this study was to investigate the degree of adherence with airway clearance and exercise regimens of an Australian sample of patients with CF, namely those attending the Adult CF Unit at the Royal Adelaide Hospital (RAH). Additionally, reasons for non-adherence and factors that improved adherence were sought from patients.

2. Methods

2.1. Development of the questionnaire

A questionnaire was specifically designed for this study, based on the Manchester Cystic Fibrosis Compliance Questionnaire [6]. The modified questionnaire went through several revisions before being tested on a pilot sample of 2 patients with CF for its clarity, ease of completion and content. Based on their feedback, further refinements were made to the content and wording of questions.

The questionnaire contained three basic sections:

- general background information (e.g. age, sex, living arrangements, co-existing medical conditions) as well as disease severity (expressed as a percentage of each patient's forced expiratory volume in one second [FEV_1] over predicted normal value) and each patient's perception of the severity of their CF disease (mild, moderate or severe)
- adherence with airway clearance techniques
- adherence with exercise regimens.

Given that exercise can be viewed as a form of airway clearance, it was also included as an option, when appropriate, in the questions relating to airway clearance techniques.

The CF Physiotherapist (DW) collected background data from medical records and a personal interview. The sections of the questionnaire relating to adherence and patients' perception of disease severity were completed in a private and confidential interview with another physiotherapist (NH), who had no personal involvement with the CF Unit or the treatment of patients with CF.

2.2. Subjects

All patients registered with the RAH Adult CF Clinic over an 18 month period were eligible for inclusion in this study. The study was performed only when patients were in a stable medical condition, either as an outpatient or at the end of a hospital admission. The CF Physiotherapist (DW) individually approached each patient regarding participation in the study and to explain the aims of the study and the format that it would take. The importance of voluntary participation, confidentiality and anonymity were stressed, and informed written consent was obtained. It was also explained to patients that honest answers were being sought and that they would not be judged by their replies.

Approval for this study was obtained from the RAH Research Ethics Committee.

2.3. Data analysis

Each patient was given an identifying number and their names were not recorded on the data collection forms. Data were entered onto an Excel spreadsheet and analyses were performed using SPSS (v14) and StatXact (v7). To enable statistical analysis of adherence with airway clearance regimens, patients were classified as being adherent if, over the last six months, they had performed their airway clearance techniques as often as advised by their physiotherapist, at least once a day every day, or if they occasionally missed one or two days of treatment. Patients were deemed to be adherent with exercise regimens if, over the last six months, they

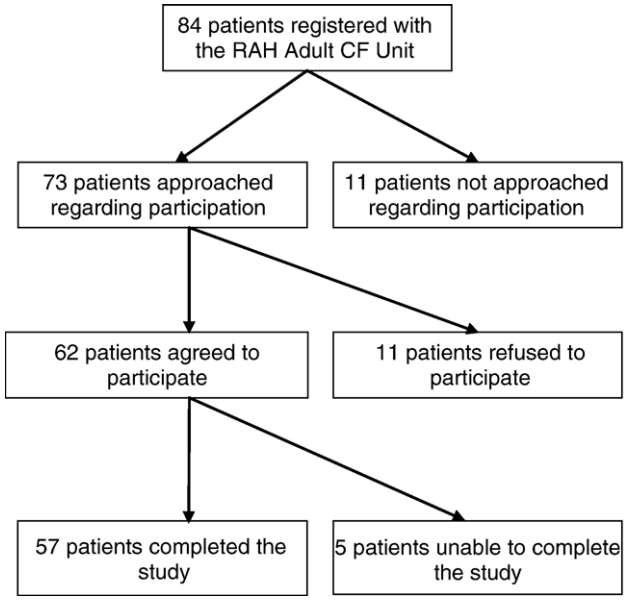

Fig. 1. Recruitment of patients for participation in the study.

had exercised strenuously enough to make them short of breath or sweat every day or four to six times a week. Comparisons of background data between participants and non-participants were made using the Chi Square test, except for age where the Independent Samples T test was used. Associations between adherence and demographic/clinical variables were analysed using non-parametric tests due to the nominal/ordinal nature of the data (Chi Square test, Kruskal–Wallis test), with the exception of age where the Independent Samples T test was used.

3. Results

3.1. Recruitment and patient characteristics

The process for recruiting patients to the study is outlined in Fig. 1. Two patients were unable to be approached regarding participation as they did not attend any clinic appointments during the 18 month study period, and a further 9 patients who attended clinic during the study period were not approached regarding participation due to patient or physiotherapist time constraints. Eleven patients refused consent, with the reasons given including: "couldn't be bothered"; "not interested"; "being in other concurrent studies"; "been in too many other studies"; "don't see the point"; "don't have time to take part". Of the 62 patients who agreed to participate, 5 patients were subsequently unable to complete the questionnaire due to time constraints on the part of the physiotherapist or patient. Thus, 57 of the 84 patients registered with the RAH CF Unit completed the questionnaire, giving a response rate 67.9%.

Table 1 provides general background information for the 57 patients who completed the study and the 27 patients who did not participate (see Fig. 1). As can be seen, the majority of participants were male and the mean age was 25.8 years. Most patients had mild or moderate disease severity as assessed by their FEV_1 percentage predicted value. No significant difference was found between participants' ratings of their disease severity and that based on FEV_1 (Wilcoxon's Signed Ranks test, $Z=-1.37$, $p=0.17$). No significant differences were found between participating and non-participating patients in terms of age, sex, disease severity, living arrangements and working arrangements (all p's ≥ 0.21).

Table 1
General information for the 57 patients completing the study and the 27 non-participants

	57 participants	27 non-participants
Age (years)		
Mean (S.D.)	25.8 (6.8)	25.1 (7.7)
Range	18–48	16–46
Sex — n (%)		
Female	23 (40.4)	9 (33.3)
Male	34 (59.6)	18 (66.7)
Living arrangements — n (%)		
Living with parents or spouse/partner	39 (68.4)	22 (81.5)
Living alone	11 (19.3)	2 (7.4)
Living with friends	7 (12.3)	3 (11.1)
Working arrangements — n (%)		
Working and/or studying full time	25 (43.9)	16 (59.3)
Working and/or studying part time	15 (26.3)	3 (11.1)
Receiving a disability pension and neither working or studying	17 (29.8)	8 (29.6)
Co-existing medical conditions — n (%)		
Diabetes	10 (17.5)	NA
Asthma	7 (12.3)	
Osteoporosis	5 (8.8)	
Liver disease	2 (3.5)	
Coeliac disease	1 (1.8)	
Disease severity — n (%)		
Mild (FEV_1 > 70% predicted value)	20 (35.1)	15 (55.6)
Moderate (FEV_1 40 — 69% predicted value)	27 (47.4)	9 (33.3)
Severe (FEV_1 < 40% predicted value)	10 (17.5)	3 (11.1)
Perceived disease severity — n (%)		
Mild	25 (43.9)	NA
Moderate	25 (43.9)	
Severe	7 (12.3)	

Percentages are expressed relative to the 57 participants or the 27 non-participants.
FEV_1 = forced expiratory volume in one second.
NA = not available.

3.2. Airway clearance regimens

Table 2 provides information regarding the actual performance of airway clearance regimens by the 57 patients and their perceptions of outcome. Over the last six months, 55 of the 57 patients (96.5%) had done some type of airway clearance techniques (chest physiotherapy and/or exercise) when they were well and all of the 54 patients who had been unwell reported doing some kind of airway clearance techniques whilst unwell. Most patients used a combination of airway clearance techniques, with the most commonly used techniques being exercise, positive expiratory pressure, coughing and the active cycle of breathing techniques. Ten patients (17.5%) reported that exercise was the only airway clearance technique they used when they were well, with 5 of these 10 patients continuing to use exercise as their sole method of airway clearance even when unwell. Immediate symptomatic improvement after doing airway clearance regimens was reported by 31 patients (54.4%) when well and 49 patients (90.7%) when unwell.

Five of the 57 patients (8.8%) reported receiving assistance with airway clearance treatment when well, with this number increasing to 18 patients (33.3% of the 54 patients who had been unwell) when unwell. The type of assistance with treatment was, in all cases, chest wall percussion, and one person also received assistance in the form of chest wall vibrations. All but one of these patients believed the assistance was beneficial in helping to clear secretions, with the remaining patient not certain if it was of any benefit. Other reported benefits of assisted treatment were that it: was less tiring (6 patients; 10.5%), encouraged them to perform more

Table 2
Performance of airway clearance techniques and their perceived outcomes

Airway clearance techniques performed over last six months	When well	When unwell
Yes	55 (96.5)	54 (100.0)
No	2 (3.5)	0
Had not been unwell	N/A	3 (N/A)
Techniques used over the last six months [a]	**When well**	**When unwell**
Exercise	45 (78.9)	41 (75.9)
Positive expiratory pressure therapy	24 (42.1)	26 (48.1)
Coughing	20 (35.1)	25 (46.3)
Active cycle of breathing techniques	18 (31.6)	21 (38.9)
Huffing	17 (29.8)	27 (50.0)
Autogenic drainage	7 (12.3)	7 (13.0)
Percussion	6 (10.5)	19 (35.2)
Postural drainage	6 (10.5)	18 (33.3)
Flutter therapy	4 (7.0)	8 (14.8)
Vibrations	4 (7.0)	5 (9.3)
None	2 (3.5)	0
Do you notice any immediate improvement after doing your airway clearance techniques?	**When well**	**When unwell**
No	24 (42.1)	5 (9.3)
Had not done any airway clearance techniques	2 (3.5)	0
Had not been unwell	N/A	3 (N/A)
Yes [a]	31 (54.4)	49 (90.7)
Less tight or congested	16 (28.1)	32 (59.3)
Less breathless	12 (21.1)	22 (40.7)
Less likely to cough	11 (19.3)	21 (38.9)
Less likely to cough up sputum	11 (19.3)	13 (24.1)
Other	11 (19.3)	8 (14.8)

Percentages are expressed relative to the total sample ($n=57$) in the first column and the number of patients who had been unwell ($n=54$) in the second column.
N/A = not applicable.
[a] Some patients gave multiple responses.

regular and effective treatment than they would otherwise have undertaken (5 patients; 8.8%), was easier than concentrating on other techniques (3 patients; 5.3%), was relaxing (2 patients; 3.5%) and enjoyable (1 patient; 1.8%).

3.3. Adherence with airway clearance regimens

The results concerning the level of adherence with airway clearance techniques are shown in Table 3. More than two thirds of patients reported that they either did their airway clearance at least once each day (10 patients, 17.5%) or occasionally missed one or two days of treatment (30 patients, 52.6%). Despite this only 21 patients (36.8%) considered that they performed their airway clearance regimen as often as they had been advised by their physiotherapist. Based on the definition of what we considered to be an acceptable frequency of treatment (see Data analysis), 40 patients (70.2%) were deemed to be adherent to airway clearance techniques. Frequency of airway clearance techniques was significantly affected by whether the patient was well or unwell ($\chi^2=5.68$, df=1, $p=0.02$), with more patients using airway clearance techniques on a daily basis when unwell than when well.

3.4. Factors influencing adherence with airway clearance regimens

Factors influencing adherence with airway clearance regimens are presented in Table 4. The most common reasons given for non-adherence were being too busy (37 patients, 64.9%), not always being bothered (37 patients, 64.9%) and being too tired (30 patients, 52.6%). Patients reported an improved adherence with airway clearance regimens when there was a deterioration in their health, for example when they felt unwell (51 patients, 89.5%), had a fall in pulmonary function tests (45 patients, 78.9%) or they were producing more sputum than usual (42 patients, 73.7%).

Adherence with airway clearance regimens was not found to be significantly affected by age ($t=1.74$, df=55, $p=0.09$), sex ($\chi^2=0.01$, df=1, $p=1.00$), living arrangements ($\chi^2=1.85$, df=4 $p=0.80$), working arrangements ($\chi^2=7.12$, df=3, $p=0.07$), disease severity based on FEV_1 ($\chi^2=1.34$, df=1, $p=0.28$), whether or not treatment was assisted ($\chi^2=2.33$, df=1, $p=0.31$) or whether or not immediate improvement was felt after treatment ($\chi^2=4.95$, df=1, $p=0.14$).

Table 3
Adherence with airway clearance techniques

Over the last six months, how often did you actually do your airway clearance techniques? [a]		
As often as advised by physiotherapist	21 (36.8)	
At least once each day, every day	10 (17.5)	
Occasionally miss one or two days of treatment	30 (52.6)	
Often miss one or two days of treatment	14 (24.6)	
Do treatment only when felt unwell	9 (15.8)	
Never do any treatment	0	
Frequency of airway clearance techniques used over the last six months	**When well**	**When unwell**
Once a day or more	38 (66.7)	46 (85.2)
More than twice a week	10 (17.5)	6 (11.1)
Twice a week or less	7 (12.3)	2 (3.7)
None	2 (3.5)	0
Had not been unwell	N/A	3 (N/A)
On average over the last six months, how long did you spend doing an airway clearance session?	**When well**	**When unwell**
More than 30 minutes	16 (28.1)	10 (18.5)
21–30 min	2 (3.5)	12 (22.2)
10–20 min	31 (54.4)	26 (48.1)
Less than 10 min	6 (10.5)	6 (11.1)
None	2 (3.5)	0
Had not been unwell	N/A	3 (N/A)

Percentages are expressed relative to the total sample ($n=57$) in the first column and the number of patients who had been unwell ($n=54$) in the second column.
N/A = not applicable.
[a] Some patients gave multiple responses.

Table 4
Factors influencing adherence with airway clearance techniques

Reasons for non-adherence [a]	
Are too busy doing other things and don't have enough time	37 (64.9)
Can't always be bothered	37 (64.9)
Are too tired to do it	30 (52.6)
Do plenty of exercise and so don't need to do airway clearance physiotherapy	26 (45.6)
Feel too unwell to do it	24 (42.1)
Find it interferes with your routine family/social commitments	23 (40.4)
Simply forget	20 (35.1)
Hate doing it	16 (28.1)
Don't feel any benefit from it	15 (26.3)
Think your disease isn't as serious as most of the other CF patients	13 (22.8)
Are worried or stressed about other things that are happening in your life	13 (22.8)
Resent having to do it	9 (15.8)
Feel worse after chest physiotherapy treatment	8 (14.0)
Find it embarrassing	7 (12.3)
Feel there is no point in doing chest physiotherapy	5 (8.8)
Have too many other treatments to do	5 (8.8)
Feel the physiotherapist places unreasonable demands on you	2 (3.5)
Have difficulty doing own airway clearance treatment	2 (3.5)
Feel that doing chest physiotherapy is worse than having symptoms such as excessive coughing	1 (1.8)
Don't fully understand why you need to do chest physiotherapy	1 (1.8)
Have to rely on someone to help	1 (1.8)
Don't like the physiotherapist and what she has to tell you	0
Don't know how to do it	0
Reasons that improve adherence [a]	
Are feeling unwell	51 (89.5)
Find there has been a drop in your lung function tests	45 (78.9)
Feel better after doing your treatment	44 (77.2)
Are producing more sputum than usual	42 (73.7)
Are coughing more than usual	41 (71.9)
Have recently been encouraged and/or advised by the doctor and/or physiotherapist to do some	35 (61.4)
Are finding it harder to cough up your sputum	34 (59.6)
Have a clinic appointment coming up	21 (36.8)
Are encouraged by your family and/or friends to do some	18 (31.6)
Someone offers to assist you with your treatment	16 (28.1)
Are feeling well	7 (12.3)

All percentages are expressed relative to the total sample ($n=57$).
[a] Some patients gave multiple responses.

3.5. Adherence with exercise regimens

The results concerning the level of adherence with exercise regimens are shown in Table 5. The majority of patients (52 patients, 91.2%) reported exercising regularly over the last six months when well, with most patients (42 patients, 77.8%) also exercising regularly when unwell. The frequency and duration of exercise reported varied considerably, but based on the definition of what we deemed to be an acceptable frequency of exercise (see Data analysis), 24 patients (42.1%) were considered to be adherent with exercise regimens. Walking was the most commonly performed exercise (41 patients, 71.9%) but over half of the patients (30 patients, 52.6%) attended a gym.

3.6. Factors influencing adherence with exercise regimens

Factors influencing adherence with exercise are presented in Table 6. The most frequent reasons for not exercising regularly were being too busy doing other things to find enough time (39 patients, 68.4%), being too tired (39 patients, 68.4%), not always being bothered (37 patients, 64.9%) and not feeling well enough to exercise (34 patients, 59.6%). Reasons that improved adherence with exercise included improved feelings of health (e.g. enjoying exercise — 45 patients, 78.9%; feeling good about oneself — 41 patients, 71.9%; getting less tired when fit — 40 patients, 70.2%;

Table 5
Adherence with exercise regimens

Do you do any regular exercise?	When well	When unwell
Yes	52 (91.2)	42 (77.8)
No	5 (8.8)	12 (22.2)
Had not been unwell	N/A	3 (N/A)
On average over the last six months, how often did you exercise strenuously enough to make you short of breath or sweat?	**When well**	**When unwell**
Every day	5 (8.8)	3 (5.6)
Four to six times a week	19 (33.3)	10 (18.5)
One to three times a week	23 (40.4)	19 (35.2)
Less than once a week but more than once a month	4 (7.0)	9 (16.7)
Less than once a month	6 (10.5)	13 (24.1)
Had not been unwell	N/A	3 (N/A)
On average over the last six months, how long did you spend exercising each week?	**When well**	**When unwell**
More than 6 h	10 (17.5)	3 (5.6)
Four to 6 h	18 (31.6)	8 (14.8)
One to 3 h	23 (40.4)	22 (40.7)
Less than 1 h	6 (10.5)	21 (38.9)
Had not been unwell	N/A	3 (N/A)
Overall, do you think your present level of exercise is:	**When well**	**When unwell**
About right	26 (45.6)	26 (48.1)
Not enough	28 (49.1)	26 (48.1)
Too much	0	1 (1.9)
Don't know	3 (5.3)	1 (1.9)
Had not been unwell	N/A	3 (N/A)
Type of exercise performed [a]		
Walking	41 (71.9)	
Gym attendance	30 (52.6)	
Cycling	16 (28.1)	
Football/soccer	15 (26.3)	
Jogging	12 (21.1)	
Swimming	12 (21.1)	
Other	55 (96.5)	

Percentages are expressed relative to the total sample ($n=57$) in the first column and the number of patients who had been unwell ($n=54$) in the second column.
[a] Some patients gave multiple responses.

Table 6
Factors influencing adherence with exercise regimens

Reasons for non-adherence [a]	
Are too busy doing other things and don't have enough time	39 (68.4)
Are too tired to do it	39 (68.4)
Can't always be bothered	37 (64.9)
Don't feel well enough to exercise	34 (59.6)
Find it interferes with your routine family/social commitments	18 (31.6)
Get too breathless when you exercise	13 (22.8)
Don't have anyone to do it with	13 (22.8)
Simply forget	10 (17.5)
Don't enjoy exercise	9 (15.8)
Are worried or stressed about other things happening in your life	8 (14.0)
Haven't got enough money to do the type of exercise you would like	8 (14.0)
Can't get motivated to start	7 (12.3)
Have too many other treatments to attend to, and exercise is of lesser importance than the others	5 (8.8)
Resent having to exercise	5 (8.8)
Feel worse when you exercise	4 (7.0)
Don't want to lose weight	4 (7.0)
Don't feel any benefit from it	0
Don't fully understand why you should exercise	0
Reasons that improve adherence [a]	
You enjoy it	45 (78.9)
It helps to clear your sputum	45 (78.9)
It makes you feel good about yourself	41 (71.9)
You get less tired when you are fitter	40 (70.2)
It gives you more energy	38 (66.7)
You don't get so short of breath when you are fit	37 (64.9)
It builds up your muscles	34 (59.6)
The physiotherapist and/or doctor has recommended that you do it	33 (57.9)
It is the most effective method of clearing your chest	27 (47.4)

All percentages are expressed relative to the total sample ($n=57$).
[a] Some patients gave multiple responses.

having more energy — 38 patients, 66.7% and helping with sputum clearance — 45 patients, 78.9%).

Adherence with exercise regimens was not found to be significantly affected by age ($t=1.75$, df=55, $p=0.21$), sex ($\chi^2=2.15$, df=1, $p=0.18$), living arrangements ($\chi^2=0.80$, df=3, $p=0.96$), disease severity based on FEV_1 ($\chi^2=0.12$, df=1, $p=0.74$), whether or not exercise was used as a form of airway clearance ($\chi^2=1.23$, df=1, $p=0.33$) or whether or not exercise resulted in positive feelings ($\chi^2=4.00$, df=1, $p=0.07$). Adherence was significantly affected by work/study arrangements ($\chi^2=9.63$, df=3, $p=0.02$), where those who worked or studied full time were more adherent with exercise regimens than others.

4. Discussion

This study found that virtually all surveyed patients attending the RAH Adult CF Unit reported that they had performed some airway clearance techniques (chest physiotherapy and/or exercise) over the last six months and the majority reported undertaking regular exercise. The frequency of performing airway clearance regimens increased significantly when patients were unwell, and adherence with exercise regimens was significantly higher in those patients who worked full time. The most common reasons patients reported non-adherence with airway clearance regimens were being too busy and that they couldn't be bothered. Similarly, being too busy and too tired were the most frequent reasons for decreasing adherence with exercise regimens. The authors considered the levels of adherence with the airway clearance and exercise regimens in this study to be satisfactory, given that it is unrealistic to expect 100% compliance from patients with chronic conditions, such as CF, which require complicated and time consuming treatments.

In terms of the study design, previous studies of adherence in patients with CF had a higher response rate when patients were approached directly [6,7,16] compared to when a postal questionnaire was used [8,17]. Therefore, a structured interview process was used in the current study in an attempt to maximize the response rate and enable immediate clarification of any major inconsistencies in response. The involvement of a neutral physiotherapist who was not involved in the RAH Adult CF Unit was specifically used in this study in an attempt to maximize the honesty of the patients' responses. The questionnaire used was based on the Manchester Cystic Fibrosis Compliance Questionnaire [6]. Although it underwent modification for use in the current study, in retrospect the authors believe that further changes are required to simplify questions and shorten its length.

Looking in more detail at the level of adherence with airway clearance techniques found in this study, although only 36.8% of patients considered that they performed their airway clearance regimen as often as advised, the authors considered that majority of the patients (70.2%) adhered to their regimen by doing it at least once each day or occasionally missing one or two days of treatment. This rate of adherence is somewhat higher than that reported in most previous studies and may reflect the approach taken by the authors to view exercise as an accepted form of airway clearance. Although Bilton et al. [18] reported that exercise has a role in sputum expectoration but should not be considered a replacement for airway clearance, Bye et al. [19] advised that airway clearance regimens could include either chest physiotherapy or exercise in isolation or in combination. Moorcroft et al. [20] also argued that CF patients enjoy and prefer exercise as a therapeutic option to most other forms of therapy. This study lends support to the latter view.

The most frequently reported reason for decreased adherence to airway clearance regimens noted in this study, namely being too busy/not having enough time, was reported with a considerably higher frequency than in previous studies. For example, insufficient time was given as a reason for decreased adherence by 64.9% of patients in this sample, compared to approximately 20 to 40% in previous research [6,7,12,17]. Similarly, patients reported that they couldn't always be bothered performing their airway clearance regimens with a higher frequency in the current study (64.9%) compared to previous research where the frequency was

approximately 35 to 40% [6,12]. Being too tired to perform airway clearance treatments was also more frequently reported in the present study (52.6%) compared to that of Carr et al (16%) [17]. The reasons for this disparity in results is not clear as demographic details such as age, work/study status and disease severity in this study were similar to those found in the previous studies. It is possible that changes seen since the previous studies (the most recent of which was published in 1996), such as the increased burden of care and increased the expectation and ability of patients with CF to lead a normal lifestyle, with its family, social, work and leisure commitments, rather than the life of an invalid, may account for the disparity in results. The most frequently reported factors that improved adherence with airway clearance techniques were associated with feelings of being unwell, and are similar to those reported by Abbott et al. [6] and Carr et al. [17]. Abbott et al. [6] found that adherence with airway clearance regimens significantly improved if patients received help with their treatment, whereas this was not found to affect adherence in the current study.

In the current study, 91.2% of patients reported exercising regularly when well, although only 42.1% were deemed to exercise to a beneficial level. Abbott et al [6] reported that 68% of their sample exercised at a beneficial level, whereas Carr et al [17] found that only 31% of their sample exercised for three or more hours per week and Shepherd [5] found that 57% exercised regularly (the amount of exercise was not quantified). The higher overall rate of adherence with exercise seen in the current sample (i.e. 91.2%) may be due to the philosophy at the RAH whereby, based on the increasing body of evidence, the importance of exercise has been stressed, both as an essential treatment in itself and also as a means of airway clearance. It is also possible that other factors such as the Australian climate being more conducive to exercise, and cultural differences, including the important role that sport plays in the Australian psyche, may be important. Furthermore, the higher levels of adherence to exercise regimens, in comparison to airway clearance regimens, may reflect that exercise is perceived as being more socially acceptable. However, while the overall rate of adherence with exercise was comparatively high in the current study, the amount of exercise undertaken was less than desired. The reasons that were most frequently reported by patients in the current study as decreasing adherence with exercise regimens were if they were too busy (68.4%) or too tired (68.4%). In previous research, similar reasons have been identified as decreasing adherence with exercise regimens [6]. An interesting finding in the current study was that adherence with exercise regimens was significantly higher in those who worked or studied full time. Although it was hypothesised that this may have reflected that those patients working/studying full time had less severe disease, this was not found to be the case on further analysis.

Given the results of this study, a number of recommendations for clinicians can be made. Firstly, it is recommended that to improve the adherence of patients with CF with their airway clearance and exercise regimens, physiotherapists should be flexible in their approach to these treatments, assisting each patient in devising an individual treatment regimen that is both acceptable and realistic when well and unwell. While reduced adherence due to a lack of time has to be acknowledged and accepted as part of the complexity of the treatment regimens required of patients with CF, the time effectiveness of airway clearance and exercise regimens must be taken into consideration as part of this. Secondly, given that many of the factors that affected adherence with airway clearance regimens were related to negative feelings associated with the treatment (see Table 4, i.e. hate doing it, don't feel any benefit of it, feel worse after treatment, feel there is no point doing it, feel the physiotherapist places unreasonable demands on you) clinicians should specifically address these concerns. Physiotherapists may also be able to address some of the factors that influenced patients' adherence with exercise regimens (see Table 6) for example, by searching for exercise alternatives that are perceived as more enjoyable or can be more easily undertaken with a friend.

5. Conclusion

For this sample of adult patients with CF, the level of adherence with airway clearance and exercise regimens was considered by the authors to be acceptable and higher than that reported previously in the literature. To improve adherence, clinicians should be flexible, considering the time effectiveness of interventions and each individual's particular needs, and emphasising the benefits of airway clearance and exercise.

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